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LIFE HISTORY OF THE TROPICAL SOD WEBWORM[1] *PACHYZANCLA PHAEOPTERALIS* GUENEE[2]

S. H. KERR[3]
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Lepidopterous larvae have long been recognized as major pests of Florida turf. During the fall of 1953, one of the largest outbreaks of these pests in Florida history stimulated further research on the biology and control of these insects, with special emphasis on the principal species, *Pachyzancla phaeopteralis* Guenee. The tropical sod webworm was severely damaging to the common lawn grasses, including St. Augustine grass, *Stenotaphrum secundatum* (Walt.) Kuntze, Bermuda grass, *Cynodon dactylon* (L.) Pers., and centipede grass, *Eremochloa ophiuroides* (Munro) Hack. It is injurious to *Zoysia* species although *Zoysia* lawns have only recently begun to be widely planted. It has been recorded as completely destructive of carpet grass, *Axonopus affinis* Chase.

Larval infestations may consist solely of *P. phaeopteralis,* or of various proportioned mixtures with the fall armyworm, *Laphygma frugiperda* (S. & A.), the grassworm, *Mocis repanda* (Fab.) and other *Mocis* species, and crambid webworms. There are cases where the other lepidopterous larvae are the most numerous, but the severe injury in 1953 was caused largely by the tropical sod webworm. This insect has also been listed under the generic name *Psara* and the specific name *cellatalis* Wlk. Forbes (1923) very much doubted that the genus *Pachyzancla* was either natural or in its right place when he listed it in subfamily *Pyraustinae,* family *Pyralididae.* The specimens of *P. phaeopteralis* were identified by Mr. H. W. Capps of the Federal Entomology Research Branch.

DISTRIBUTION

P. phaeopteralis apparently has a wide tropical distribution. Grossbeck (1917) stated that it "occurs throughout the 'tropical zone' according to Hampson". Wolcott (1936) claimed that *P. phaeopteralis* is widely reported in Puerto Rico, and Longstaff (1912) said it is widespread in Jamaica and commoner than

[1] This common name is proposed for *Pachyzancla phaeopteralis* Guenee.
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many moths observed in Ceylon. This webworm apparently is common throughout most of Florida although indications are that it does not survive the winter in the northern part of the state. Records of its occurrence in Florida date back to 1914. This insect probably occurs along much of the Gulf Coast. It was the cause of injury to turf in Georgia in 1953, and occasionally it has been damaging in Louisiana since 1933.

DESCRIPTION OF DIFFERENT STAGES

EGG: One of the more striking differences between *P. phaeopteralis* and crambid webworms appears in the egg stage. Crambids commonly drop ridged, more or less barrel-shaped eggs at random as they fly about over the grass. These eggs fall singly and being dry, sift down through the grass foliage. The eggs of the tropical sod webworm, as observed repeatedly in rearing cages, were much different. Usually they appeared in clusters of six to fifteen eggs, although some were laid singly. The masses were placed both on grass blades and on the moist blotting paper floor of the cages. Within the mass the eggs partially overlapped each other. The eggs were flattened and more or less round in outline. Individual eggs measured about 0.55 mm. across their shortest dimension and about 0.70 to 0.73 mm. across their widest part. They were about 0.1 mm. in height. The clusters differed in size but several measured between 1.4 and 1.8 mm. by 1.6 and 2.4 mm. The eggs were whitish when laid but soon became brownish red. Eye spots appeared as dark red spots and shortly before hatching, the curled up larva with its dark head was easily visible through the thin membrane.

LARVA: The larva has a dark, yellowish brown head. The body is a dingy cream color, although it appears mostly green when the insect has fed on grass foliage. The tropical sod webworm is distinguishable from other *Pachyzancla* species and from *Crambus teterrellus* Zinck—which is common in much of Florida—by the arrangement of the panicula and spiricals on the thoracic segments.

PUPA: The pupae are not markedly different from those of some of the crambid species. They may lie free or partially buried in the duff on the surface of the soil, or they may be enclosed in a shapeless bag which the larva spins and which may incorporate bits of grass and soil particles in the outer surface. The pupae range in size from 8.5-9.5 mm. in length by 2.1-2.9

mm. in width. Their color is reddish brown overall, although shortly before emergence the head and wings may appear almost black.

TABLE 1.—MEASUREMENTS OF LARVAE. AVERAGE OF 10 INDIVIDUALS.

Instar	Body Length	Head Capsule at Widest Point
1st	1.2 mm.	0.255 mm.
2nd	2.7 mm.	0.344 mm.
3rd	4.1 mm.	0.489 mm.
4th	6.0 mm.	0.676 mm.
5th	8.4 mm.	0.944 mm.
6th	11.3 mm.	1.267 mm.
7th	17.3 mm.	1.607 mm.

ADULT: The adults are dingy brown colored moths with a wing spread of about 20 mm. They can be distinguished from the crambids by the fact that the tropical sod webworm adults do not roll their wings about their bodies when at rest. The males are easily separated from the females by observing the shape and number of the abdominal segments. The male usually has a slimmer abdomen and, counting from the posterior end on the ventral side, there are six segments up to, but not including, the one which is cut away ventrally where it rests against the thorax. The female only has five segments to the one resting against the thorax. The anal segment of the female has a large fusiform opening, while the last segment of the male has a slight extension on the dorsal side and the feathery appearing sexual organs may sometimes be seen protruding.

NATURE OF INJURY TO TURF

The larvae cause damage by chewing the grass foliage. Injured grass blades have a notched and ragged appearance. Where the feeding goes unchecked the turf looks extremely closed cropped. Webworm damage usually appears in patches. These become yellowish to brownish as the foliage is progressively chewed off, exposing stolons and dead pieces of grass. Usually lawns recover from the damage but sections of lawns have been killed. Death of the grass is more likely when there is insufficient moisture to keep the plants growing actively.

In Florida, turf injury begins in some areas in the spring, but the injury in 1953 in northern Florida reached epidemic proportions in the fall.

LIFE HISTORY

In general, the tropical sod webworm has a life history similar to the crambid sod webworms. The time from egg to adult appears to be close to six weeks. The continued outbreaks during the summer and fall seasons are more likely from overlapping broods rather than from very rapid development. Life history observations were made in the field and in the laboratory.

ADULTS: Field-collected adults of *P. phaeopteralis* were placed in lantern globe cages over moist blotting paper in a petri dish. Pieces of St. Augustine grass were placed on the blotting paper. No eggs were laid by the moths until a one molar sucrose solution with 8 percent by weight of brewers yeast was introduced in bottles with a cotton wick. Less yeast would very likely have served as well and possibly the moths only needed access to moisture. It seemed as important, too, not to disturb the moths for several days at a time, so it was not possible to make a close daily check on when and how many eggs were laid.

Adults confined in shell vials with no provision for food or humidity control lived about 3.5 days. Individuals caged in lantern globes over moist blotting paper but with no food lived about 6 days, the males averaging 4 and the females 7 days. When the sucrose and yeast solution was added to the lantern globe cages, the field-captured adults lived an average of about 14.5 days or twice as long. Temperature was a factor, too. The above figures are for an open insectary in autumn weather. Adults handled concurrently in a hotter, drier office lived only 1 or 2 days without food and an average of nearly 5 days with it. Again the females outlived the males. Moths reared in the laboratory lived only a few days longer under the warm indoors conditions—5 to 8 days for the males and 5 to 11 days for the females.

In Gainesville, the peak of adult emergence was in October and November. During the day most of the adults rested in shrubbery around the lawns. Veritable clouds of moths could be disturbed into flight by shaking the shrubbery during the height of the flight in the 1953 outbreak. The moths were also

found among the grass foliage, and the author was able to collect considerable numbers quickly by picking them off of the walls and screens of the house adjoining an infested area. Flight appeared relatively weak during the day and disturbed moths usually fluttered only 10 to 20 feet before settling down again. At dusk they flew more strongly, staying in the air continuously and sometimes covering considerable distances over the lawn and spreading out to the other lawns. They were observed to alight on the grass from one to five seconds and then continue on. During these evening flights, the moths usually remained within two feet of the ground. Whenever the adults were handled in the laboratory, it was obvious that the males were the more active. It was noted one evening when the temperature had lowered to 58° F. that the moths were completely inactive. Two days later when the sun was shining brightly in the morning the air temperature was no higher but the rays of the sun were warming enough so that the moths were fluttering slightly and an occasional one even took wing. Of 279 adults examined, 58 percent were females.

EGGS: Damage to the turf is usually observed to start near flower and shrubbery borders. Possibly since the adults rest in such foliage, more eggs, or at least the first ones, are laid near the edges. The least amount of observations is available for this stage, but from laboratory data it is surmised that the eggs are laid on the foliage and stems of grass and perhaps on pieces of sticks and leaves that may be among the foliage. Oviposition apparently occurs largely at dusk. The eggs hatched in six to ten days at temperatures in the high seventies Fahrenheit.

LARVAE: Ten larvae were reared under closely watched conditions at a temperature fluctuating few degrees around a mean of about 78° F. Five were reared at a constant temperature of 72 to 74° F. All were kept singly in 9 cm. covered petri dishes floored with two layers of moist blotting paper. They were fed St. Augustine grass clippings fresh daily. The four to six degree drop in temperature practically doubled the length of the larval stage. At 78° the number of larval instars was typically seven and the number of days to complete this stage 25. At 73° the number of instars was typically eight and the time 45 to 50 days. Although the larvae ate their cast skins, the head capsules were not ingested and served as an indicator that molting had occurred. Further, the ingested skin could easily

be seen as a dark spot in the alimentary canal. It usually passed through the insect within 24 hours. The larvae reared at the lower temperature occasionally did not eat their cast skins.

TABLE II.—DAYS TO COMPLETE LARVAL DEVELOPMENT.

	Instar								
	1	2	3	4	5	6	7	8	Total
Days at 78° F.(*)	3.4	3.0	3.9	2.8	2.6	3.4	5.7		24.7
Days at 72° F.(†)	4.2	4.6	4.6	4.6	5.0	6.8	7.0	9.5-12.8(‡)	45-50(‡)

* Average of 10 individuals.
† Average of five individuals.
‡ No opportunity to observe exact dates.

Newly hatched larvae are small, measuring just over one millimeter in length, but they are active and have little trouble reaching the grass foliage. In the laboratory many of the tiny new larvae fed along the midrib on the inside of the V-shaped sections of St. Augustine grass. The new larvae fed on all parts of the blade but the "floored" bottom section of the inside of the V seemed particularly attractive. Through their first three or four instars, the larvae did not chew through the leaves but they fed along one side, stripping off the cells in a straight path lengthwise of the leaves. Thus longer and shorter strips were taken out of one side of the blades. The frass was found in a continuous strip along the feeding path. This scraping away of cells along one side of the leaves by young larvae is a negligible and hardly noticeable injury. Not until the webworms had but 10 to 12 days of larval life remaining did they begin to devour whole portions of the leaves and only in the last five or six days were large amounts eaten. It somewhat justifies the exclamation often made by homeowners that the damage "appeared overnight". When within a day or two of their sixth instar, eight of 10 laboratory-reared larvae started to chew out complete sections of leaf; the other two did not start until their sixth larval instar. A record was kept of the amount of leaf areas consumed by these ten individuals. Their food was St. Augustine grass blades which were six to seven millimeters in width. The following averages are in columns aligned under "days after hatching" rather than under amounts eaten on first day of sixth instar, second day of sixth instar, etc. This seemed a better procedure, for although all of the individuals hatched

within 48 hours, the time to reach a given molt varied up to five or six days.

TABLE III.—LENGTH OF GRASS CLIPPINGS DEVOURED DAILY PER LARVA (AVERAGE FOR 10 LARVAE)

	Days After Hatching											
	14	15	16	17	18	19	20	21	22	23	24	25
Length in mm.	11	17.4	19.3	24.1	40.7	44.6	69.7	78.0	119.3	123.6	101	71

Table III shows that a larva averaged 540 mm. or 20.3 inches of grass eaten in the last 12 days of its larval life, with four to seven inches being eaten daily through the last few days. Rough estimates of the amount of foliage in a square yard indicate that a population of up to 200 larvae per square yard could not strip the leaf material off entirely. This is the case in the field, and although a lawn may be severely chewed back the grass can almost always quickly recover when the larvae pass to their next stage and if the grass is managed so that it is growing actively. The larvae are active only at night and are quite sensitive to light. They remain hidden down below the grass foliage during the day.

The resting position of the larva is tightly curled, and in the field these insects are easily found lying curled up on the soil surface when one parts the grass foliage. Sometimes they spin a shapeless silken bag which incorporates bits of grass and soil in the outer surface, but this is not done by all individuals even when pupation time is near. The larvae left trails of silk along the blades of grass where they traveled and frequently bound themselves to the grass clippings with a few strands of silk when they rested during the day. When disturbed, the larvae could travel rapidly forward or backward with apparently equal facility although the normal action is forward.

PUPAE: At the higher rearing temperature of about 78° F. the pupal period was seven days. At 72° F. it averaged 15.5 to 16.8 days, daily observations of the latter not being possible. Field-collected individuals held for observation under outdoor temperatures varied considerably in length of pupal stage. When they pupated in the last week of October, the stage lasted 12-13 days, but the pupal period was three to four weeks when they

pupated in the first week in November. The time from the observed peak of larval damage in the field to the peak of adult emergence coincided very closely with the predicted time from laboratory work.

OVERWINTERING STAGE: The observations made lead the author to surmise that the tropical sod webworm does not overwinter above central Florida in most years, and that it overwinters only where all stages can continue to develop. In Gainesville, it appeared that the pupae and adults could survive the winter temperatures but new broods could not get started. Probably few if any eggs were laid by the late emerging adults, and even if a few eggs did hatch in the winter, the small larvae could not survive. Thus, the population was slowly reduced until none were left alive above the middle and lower parts of the state. In Gainesville, larvae were not found again until July. Repeated laboratory and field observations showed that reduced temperatures had a marked effect on the larvae. It was pointed out above that a drop of about 5 degrees in rearing temperature nearly doubled the time for larval development, and the young larvae in cages perished at outdoor temperatures in December when the overnight readings dropped into the low forties Fahrenheit. Further, the larvae in the field became so sluggish at temperatures in the mid-sixties that they could rarely be brought to the surface to be collected even when a pyrethrum solution was soaked into the turf to agitate them and bring them up. This collecting method was not very successful unless the temperature was at least 70° F. and with the sun shining brightly.

One might suggest that if some eggs hatched in late October or early November the larvae would be large by December and should be able to survive the winter as is the habit with large crambid larvae farther northward. Actually, eggs of some of the overlapping generations were hatching through October and early November but this apparently did not work as an overwintering device either. In northern Florida the winter temperatures do not remain at a low level. There are periods of days at a time when the daytime temperature is in the high seventies and may reach the low eighties. This serves to keep the larvae and pupae developing and the adults continue to emerge. It was mentioned earlier that adults emerged into February. The 1953-54 winter was relatively mild in the Gainesville area and so the surmise seems fairly well supported from the observa-

tions available that this tropical species is killed back southward in the winter. Apparently there is no single overwintering "stage" and all stages are present where it is warm enough for the insect to last through the year.

PARASITES

The only parasites noted emerged from the nearly mature larvae. Of 25 larvae brought in from the field and held for observation, eight, or about one-third, were parasitized by Ichneumonid wasps. There are several records of such parasitism on file at the Florida Experiment Station and all of the parasites have been identified as *Horogenes* sp. by L. M. Walkley of the Federal Entomology Research Branch.

SUMMARY

The tropical sod webworm, *Pachyzancla phaeopteralis* Guen., was the principal species involved in the unusually severe outbreak of lepidopterous larvae on Florida lawns in 1953. It was determined that at about 78° F. this insect could develop from egg to adult in about six weeks. The eggs, which were flattened and sometimes laid in clusters, hatched in six to ten days. There were seven larval instars requiring about 25 days for completion, and the pupal stage lasted about seven days. Lowering the rearing temperature about five degrees nearly doubled the length of the larval and pupal stages, and it is surmised that this tropical species can not survive the winter temperatures of northern Florida.

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RELATION BETWEEN SWEET CORN SILKING AND EARWORM INFESTATION IN THE LOWER RIO GRANDE VALLEY OF TEXAS

GEORGE P. WENE [1] and R. A. BLANCHARD [2]

Varying degrees of success have attended attempts to control the corn earworm [*Heliothis armigera* (Hbn.)] on sweet corn with sprays and dusts in different areas of the United States as well as during different seasons of the year in the same areas. Much of this variation in effectiveness of control measures can be traced to the infestation level of the earworm. Dusts especially are more effective when the infestation is light or moderate than when it is severe. However, DDT-oil emulsion sprays have at times also shown considerable variation in effectiveness even when they were apparently timed and applied properly.

Barber (1943) brought out the fact that the earworm moth will oviposit on all parts of the corn plant. His studies showed that "larvae that hatch from eggs laid on plants before silks are exposed feed on whatever parts of the plants are most attractive at the time of hatching, the most suitable of which are the tender leaves of the whorl and the green tassel." He states further that "these larvae may migrate to the ears over a period of several days and they offer one of the greatest difficulties in the control of the insect in the ears." However, with the development of better methods of applying DDT-oil emulsion sprays, these migrating larvae have not been difficult to control. Chamberlain (1951) found that the earworm could be controlled in South Carolina in spring-planted corn with sprays applied after the corn began to silk, but that two pre-silking sprays were necessary for summer-planted corn because infestation was occurring before the silks appeared. With the addition of pre-silking sprays to those applied after silking, excellent control of the earworm was secured with a DDT-oil emulsion.

In the Lower Rio Grande Valley of Texas, the first fields to come into silk in any particular area often have had small earworms in the silk channels of young ears before any silks emerged. In most cases these appeared to originate from eggs

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laid on the ear shoots. Ear shoots with long flag leaves seemed particularly attractive to the moths. Where eggs were laid on the embryo ear below the entrance to the silk channel the newly hatched larvae bored through the tender husks to reach the ear. Larvae from eggs on the flag leaves above the silk channel fed slightly on the flag leaves and then entered the silk channel to the developing silks.

TABLE 1.—DEVELOPMENT OF EARWORM INFESTATIONS ON THREE SWEET CORN HYBRIDS IN THE LOWER RIO GRANDE VALLEY OF TEXAS, 1951.

Date in May	Percent of Plants Silking	Avg. No. Eggs per Silk	Percent of Ears with Larvae In Silk	Percent of Ears with Larvae On Ear Tip	Avg. No. of Larvae per Ear
			Ioana		
1	11	—	—	—	—
2	44	9.0	60	0	0.8
4	79	5.5	70	0	1.7
6	93	3.5	90	0	5.9
7	91	3.1	100	40	4.7
			Flagship		
2	0	—	—	—	—
3	18	1.8	90	0	1.0
4	41	5.5	100	0	2.8
5	46	4.7	100	0	1.2
6	67	3.6	100	0	3.2
7	89	1.5	90	0	1.9
8	83	1.5	80	30	2.9
9	97	0.6	100	40	2.3
10	98	0.9	100	60	2.3
			Golden Security		
13	0	—	—	—	—
14	8	4.7	0	0	0
15	33	3.7	40	0	0.5
16	48	3.5	60	0	0.6
17	69	1.7	70	0	1.0
18	83	3.1	90	0	2.0
19	88	1.8	70	0	1.2
20	96	1.5	70	20	1.8
21	99	1.9	80	40	1.9

In 1951 earworm infestation records were taken in three sweet corn hybrids isolated by several miles from other corn near LaVilla, Texas. The data are shown on Table 1. The percentage of plants silking was determined by counting the number of silks showing on 100 consecutive plants in five areas taken at random in each field. Then ten consecutive ears with silks showing were examined for the number of corn earworm eggs and larvae. The greatest egg population per silk occurred before 50 percent of the sweet corn plants had silked. After that time some of the silks had started drying, and the moths were laying eggs only on the fresh silks. A high percentage of the

TABLE 2.—DEVELOPMENT OF EARWORM INFESTATION ON SWEET CORN IN THE LOWER RIO GRANDE VALLEY OF TEXAS, 1952.

Date in April	Percent of Corn Ears Silking	Percent of Flag Leaves with		Percent of Silks with		Number of Larvae per Silk	Inches Larval Penetration in Silks
		Eggs	Larvae	Eggs	Larvae		
Golden Security							
14	0	12	12	—	—	—	—
15	0	20	32	—	—	—	—
17	6	20	36	—	—	—	—
19	11	28	64	100	0	—	—
21	49	0	80	—	94	4.9	0.25 to 2.0
23	66	—	—	55	60	—	—
25	94	—	—	92	65	4.1	0.25 to 2.5
27	—	—	—	—	100	5.4	1.5 to 4.0 (ear tip)
Calumet, Field No. 1							
15	0	20	40	—	—	—	0.25 to 2.0
18	1	32	32	—	—	1.1	0.25 to 2.0
21	5	7	75	100	100	3.0	0.25 to 1.0
23	—	0	67	100	100	3.8	
26	96	—	—	100	100	5.0	0.25 to ear tip
Calumet, Field No. 2							
21	8	33	33	67	75	1.6	0.25 to 0.5
24	65	—	—	92	61	2.5	0.25 to 0.5
27	92	—	—	100	100	5.6	0.25 to 1.0
29	100	—	—	—	100	7.5	1.0 to ear tip

silks contained earworm larvae on one or two days after the silks had appeared. These larvae must have developed from eggs laid on the flag leaves as sufficient time had not elasped for the eggs to be laid on the silks and then hatch. Some of the larvae had eaten their way down to the ear tip in a period of five or six days after the first silk had appeared in the field.

Similar data were taken in 1952 from the first fields to silk near Mercedes, Texas. In addition, data were taken on the number of earworm eggs and earworms present on potential ears before silking occurred in the field, as well as after silking started. The data are presented in Table 2. A large percentage of the potential ears were infested with eggs and larvae before a single silk appeared in the field. In one case, larval penetration was as much as 2 inches in the silk channel even before the silks were extruded.

SUMMARY

Data are presented showing that in the Lower Rio Grande Valley of Texas earworm larvae infested as high as 32 percent of the potential ears before the silks appeared in the field. Earworm larvae were found in the silk masses before and very shortly after silking began in the field.

RECOMMENDATION

To obtain maximum control of the corn earworm in areas where the infestation is likely to be very severe, and when no other corn in the vicinity is in silk, insecticide applications should be started after the ears have partly formed and at least 2 or 3 days before the first silks appear in the field. Growers should consult their county agricultural agent or State agricultural experiment station for latest recommendations on corn earworm control.

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THE ABUNDANCE OF *IXODES SCAPULARIS* SAY AS AFFECTED BY BURNING[1]

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Several investigators throughout the world have studied the effects of fire on the abundance of ticks. Fricks (1915) reported that grass burning was one method used in efforts to control the Rocky Mountain wood tick during early investigations of that species. de Jesus (1935) recommended the burning of pastures as a control for the cattle tick in the Philippine Islands. Buck (1935) recommended brush burning as a method of tick control in Madagascar. Bishopp (1932) reported that neither burning nor plowing pastures destroyed all specimens of the cattle tick. Smith et al (1946) noted that wildfires greatly reduced the abundance of adults of the American dog tick, *Dermacentor variabilis* (Say), in Massachusetts.

The study reported here on the black-legged tick was only one phase of a much broader investigation of the biology and ecology of this tick in northern Florida. Data were obtained on this phase of the study during the years 1950, 1951, and 1952.

METHODS

Areas selected for sampling, henceforth referred to as blocks, were located in a typical pine-palmetto flatwoods area in Alachua County, Florida. Blocks of approximately one square mile, or larger, were selected for sampling based upon their histories of forest fires. Blocks I, II, and III had histories of frequent and recent fires. Block I was last burned one year before sampling, block II two years before sampling, and block III three years before sampling. Block IV, which was considered non-burned in this study, was last burned approximately 14 years prior to sampling. Blocks were divided into plots approximately 200 feet in width and 1,500 feet in length. Plots were adjacent to roads or plowed fire lanes.

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[1] Taken from a thesis presented to the Graduate School, University of Maryland, in partial fulfillment of the requirements for the degree, Doctor of Philosophy.

[2] The author is indebted to Dr. W. D. Hanson, Department of Agronomy, College of Agriculture, University of Florida, for his assistance on the statistical phase of this study.

Other than the obvious effects of fire on the density and growth habit of the vegetation, there were no apparent differences in soil type, vegetation, and topography of the various blocks studied. Blocks were contiguous and were separated only by plowed fire lanes, roads, and wire fences. All blocks were grazed throughout the period of study.

Randomized samples of 500 steps each were taken in a similar manner with a cloth drag in all blocks on each sampling date. Ticks were collected from the drag at intervals of 25 steps. When weather conditions and time permitted, two plots were sampled in each block on the same date. Samples were taken only during the seasonal period of activity of the adult stage of the tick, which is in the fall and winter months. Only the adult stage of the tick was considered in recording sample counts.

RESULTS

The data for three years are shown in Table I. More blocks were included during the 1950 season than could be sampled effectively. This resulted in fewer samples per block that year. Samples from block III were not taken in 1950.

A study of the data in Table I shows a relatively small total number of ticks collected in all blocks. This is attributable to several factors. It was noted by studying the behavior of this tick in field cages that the adults will climb vertical vegetation when stimulated by the presence of a host, but the ticks return to ground level after a few hours if a host is not found. Ticks at the ground level have poor chance of clinging to a cloth drag. Many ticks that made contact with the cloth were dislodged before the sample was completed and were not included in the sample count. Thus, the data in Table I are not indicative of the true population density of this tick in the areas studied, but represent only sampling comparisons between blocks.

In order to eliminate some negative samples and a few missing plot samples, the samples were grouped in pairs and the average number of ticks of the combined samples was used as the basis for analysis.

An analysis of the 1951 data showed no significant difference between blocks for that year. This was probably due to variability within samples and the small total number of ticks collected. However, since data are comparable in Blocks I, II, and IV for all three years, these data were combined and years were used as replications in the analysis. Analysis of these

data (Table II) showed a highly significant difference between blocks.

TABLE I.—TOTAL COLLECTIONS OF ADULTS OF *Ixodes scapularis* SAY DURING 1950, 1951, 1952

Year	Sample Number	Block I	Block II	Block III	Block IV
1950	1	0.0	0.0	—	3.0
	2	0.0	1.0	—	8.0
	3	0.0	1.0	—	0.0
	4	0.0	0.0	—	3.0
1951	1	0.0	0.0	1.0	0.0
	2	0.0	0.0	1.0	7.0
	3	0.0	0.0	0.0	0.0
	4	0.0	3.0	0.0	0.0
	5	2.0	0.0	0.0	4.0
	6	0.0	—	2.0	6.0
	7	0.0	—	1.0	3.0
	8	0.0	2.0	3.0	3.0
1952	1	1.0	6.0	0.0	3.0
	2	0.0	1.0	1.0	3.0
	3	0.0	0.0	1.0	9.0
	4	0.0	6.0	3.0	0.0
	5	1.0	1.0	1.0	2.0
	6	0.0	4.0	2.0	3.0
	7	0.0	0.0	1.0	3.0
	8	1.0	2.0	1.0	10.0
	9	0.0	3.0	0.0	6.0
	10	0.0	1.0	3.0	3.0
Totals		5.0	31.0	21.0	79.0

TABLE II.—AVERAGE NUMBER OF TICKS/COMBINED SAMPLE IN BLOCKS I, II, AND IV DURING 1950-'51-'52.

Year	Block I	Block II	Block IV
1950	0.00	0.50	3.50
1951	0.25	0.88	2.86
1952	0.30	2.40	4.20
Totals	1.55	3.78	10.56
Mean	0.18	1.26	3.52

l.s.d. at 5%: 1.20; 1%: 1.98.

Data are comparable for all blocks for the years 1951 and 1952 (Table III). There was a significant difference between blocks when these data were combined and years were used as replications.

TABLE III.—AVERAGE NUMBER OF TICKS/COMBINED SAMPLE, ALL BLOCKS, 1951-'52.

Year	Block I	Block II	Block III	Block IV
1951	.25	.88	1.00	2.86
1952	.30	2.40	1.30	4.20
Totals	.55	3.28	2.30	7.06
Mean	.28	1.64	1.15	3.52

l.s.d. at 5%: 1.65; 1%: 3.04.

Further analysis of data in both Tables II and III gave a highly significant difference between the average number of ticks collected in the control block and the average of the combined collections from all burned blocks. There was no significant difference between collections in blocks I, II, and III.

DISCUSSION AND SUMMARY

From the results of this study it is concluded that there are fewer adults of the black-legged tick in recently burned areas of the flatwoods of northern Florida having histories of frequent burning than in areas not burned for at least 14 years. The results also show that more than three years without fire are required in the frequently burned areas for populations of this tick to attain a level comparable to that of areas considered non-burned in this study.

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A NEW AMERICAN GENUS OF VELIIDAE (HEMIPTERA)

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The present paper was prompted by the discovery of an interesting addition to the veliid fauna of the salt marshes in southernmost peninsular Florida. This proved to be the species originally described as *Microvelia turmalis* by Drake and Harris (1933) from British Honduras. It was transferred by them later (1936) to *Xiphovelia* Lundblad, 1933, a genus whose type and only species was collected in Sumatra. Further study of the Florida material discloses that *turmalis* Drake and Harris is generically distinct from *Xiphovelia ensis* Lundblad, and it is here made the type of the new genus *Husseyella*.

Husseyella belongs to the subfamily Microveliinae, which is characterized as follows: Ocelli absent. Tarsal formula 1, 2, 2; all claws pre-apical. Apical segment of middle tarsi not deeply cleft, and without plumose hairs arising from the base of such cleft. Hemelytra, when present, with four closed cells, not divided into distinct corium and membrane.

Husseyella,[1] new genus
(Fig. 1)

Head strongly deflected before the eyes. Gular region short, not longer than an eye. Hind margins of eyes subcontiguous with pronotal margin. Antennae slender; first and second segments subequal, third longest, slightly longer than fourth; first segment surpassing apex of head by one-half of its own length. Rostrum surpassing hind margins of front coxae; pre-apical segment thickened beyond base, then gradually tapering apically, about twice as long as apical segment.

Pronotum of apterous form more than twice as wide as long; anterior lobe about three-fourths as long as posterior lobe, the lobes separated by a transverse impression; hind margin of posterior lobe convex behind, mesonotum and metanotal triangles visible at sides (fig. 1, G).

Legs (fig. 1, B, D, F) relatively long and slender; middle legs one-half longer than entire body, hind legs about as long as the body; hind femora slightly surpassing apex of abdomen; hind tibiae straight in both sexes. Middle acetabula far removed from front acetabula and contiguous with the hind ones, much as in *Rhagovelia*. Prosternum and metasternum about equally long on the median line, mesosternum about twice as long as either. Metathoracic orfices placed laterally at base of hind acetabula, as in *Microvelia*, and with a spine-like tuft of setae arising within the orifice.

[1] Named for Dr. Roland F. Hussey, whose many contributions to the study of Hemiptera are well known to entomologists.

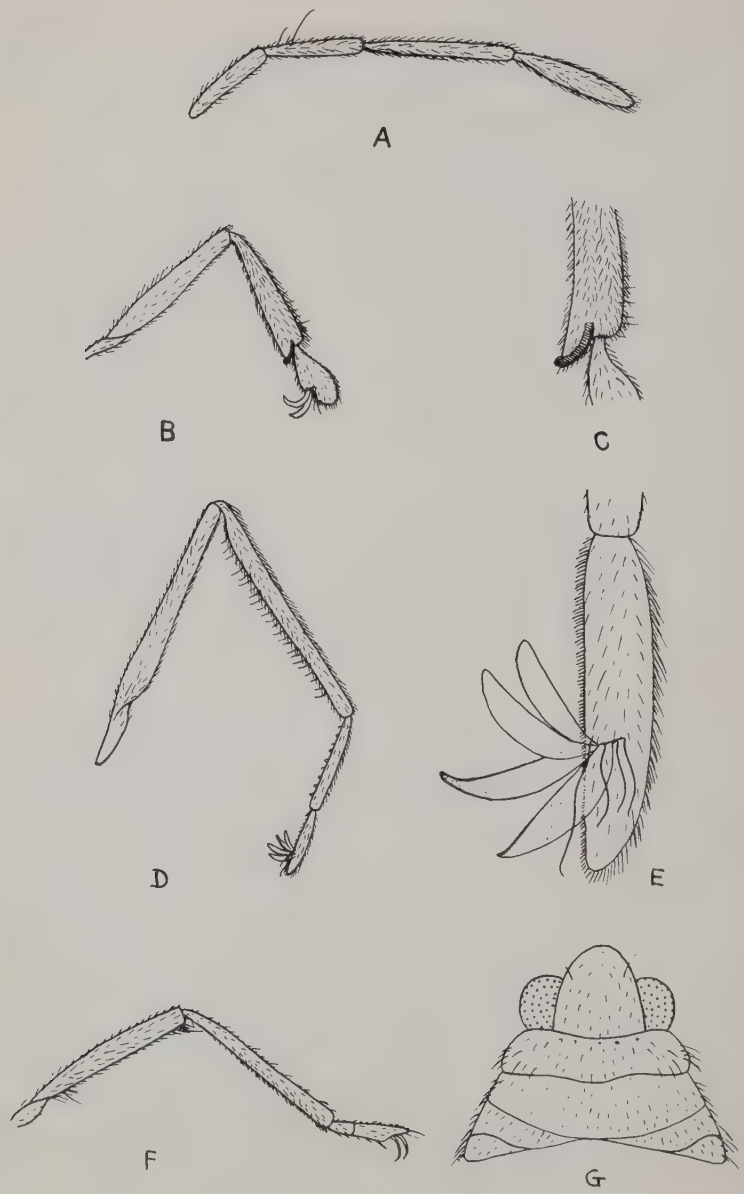

Figure 1. *Husseyella turmalis* (Drake and Harris), ♂
A. Antenna. B. Fore leg. C. Distal end of fore tibia. D. Middle leg. E. Last segment of middle tarsus. F. Hind leg. G. Head and pronotum.

Fore tarsi laterally compressed, widest at or beyond middle, claws inserted somewhat beyond middle of the single tarsal segment. Fore tibiae of male with an apical spur whose edge is covered by a comb composed of many fine teeth (fig. 1, B, C). Middle and hind tarsi 2-segmented, cylindrical.

Tarsi of middle legs two-thirds as long as the tibiae, first segment one-half longer than second, provided (in males only) with a row of small, peg-like teeth on its ventral edge; second tarsal segment with the claws and arolia (?) modified into four broad, flat, thin, blade-like structures (fig. 1, E), the outer two (claws) thicker and preserving a somewhat claw-like outline, the inner pair (arolia?) pellucid, thinner, and membranous, more rounded at the tips but virtually of the same size as the outer pair, all of these, together with several long hairs, inserted on the second segment somewhat beyond the middle; claws and arolia similarly formed in both sexes. Middle tibiae with a row of long erect hairs on ventral side, some of these hooked at the tips. Hind tibiae more than twice as long as hind tarsus; first tarsal segment much shorter than the second; claws normal, inserted slightly before apex of second segment.

GENOTYPE: *Microvelia turmalis* Drake and Harris, 1933. Also included: *Microvelia diffidens*[2] Drake and Harris, 1933, from Brazil, a specimen of which has been examined.

This new genus runs to *Xiphovelia* Lundblad, 1933, in the keys to the genera of Veliidae by China and Usinger (1949). It is easily distinguished from that genus by having the middle acetabula closely approximated to the hind ones and far removed from the front pair, whereas in *Xiphovelia* (as in *Microvelia*) the middle pair is nearly equidistant from the other two, according to information kindly furnished in correspondence by Dr. Lundblad. Other distinguishing characters are the relative lengths of the tarsal segments on the middle legs, and the presence of four, rather than three, blade-like plates on the middle tarsi. In *Xiphovelia* the middle tibia is less than twice as long as the second tarsal segment, and this one is considerably longer than the first, while in *Husseyella* the tibia of the middle leg is three times as long as the second tarsal segment, which is notably shorter than the first one. The peg-like teeth on the basal segment of the middle tarsus of the male are reminiscent of similar denticles on the middle femora of males of the Madagascan genus *Millotella* Poisson, 1948.

The following table gives measurements, expressed in millimeters, of both sexes of *Husseyella turmalis* (Drake and Harris). The measurements for the male are averages of three

[2] This new emendation, for *M. diffidentis* D. & H., is mandatory under the 1953 "Copenhagen Decisions on Zoological Nomenclature," Paragraphs 71, 72, 73, and 81.

specimens; those of the female were taken from the single specimen at hand. The femora were measured along the ventral margin.

	♀	♂
Total length of body	2.32	1.99
Greatest width of body	1.26	1.03
Antennal segment I	.30	.31
II	.30	.32
III	.47	.48
IV	.42	.43
Length of head	.36	.44
Width of head	.71	.66
Interocular width	.42	.40
Width of eye	.14	.13
Anterior pronotal lobe, median length	.20	.21
Posterior pronotal lobe, median length	.27	.24
Fore leg: Femur	.88	.84
Tibia	.57	.56
Tarsus	.31	.26
Middle leg: Femur	1.35	1.37
Tibia	1.24	1.15
Tarsus I	.46	.45
Tarsus II	.33	.32
Hind leg: Femur	.91	.87
Tibia	.88	.78
Tarsus I	.11	.10
Tarsus II	.28	.24

The material of *H. turmalis* that I have studied was collected by myself from salt water on the east coast of Florida, 2.5 miles southeast of Perrine, in Dade County, on April 8, 1948. The area is a mangrove swamp, with a small, sluggish, muddy, tidal stream that flows through a culvert beneath the road. These water-striders were extremely active and hard to capture. Several hours were spent in securing the four adults and six nymphs that I have examined. Further collecting along the southern coast of Florida and on the Florida Keys failed to produce additional material.

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Cotton Boll Weevils	Southern Corn Rootworms
Crickets	Strawberry Crown Borers
Cutworms	Strawberry Weevils
Earwigs	Sweet Clover Weevils
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REPRESENTATIVES IN PRINCIPAL CITIES

A NEW HOPLOTHRIPS (THYSANOPTERA) FROM FLORIDA [1]

J. DOUGLAS HOOD
Cornell University

That part of the large cosmopolitan genus *Hoplothrips* to which the present species belongs, because of the great disparity between the different forms of both the female and male, and the large amount of variation within each form, is one in which the description of species is difficult. Too, the decision that any species of this genus is new is a precarious one to make, because many of the older names are based upon only one of the several forms which may be presumed to exist; and no matter how well-mounted was the author's material, how thoroughgoing his description and measurements, or how accurate his drawings, there is no way, except as the result of experience—and then only approximately—even to surmise what the other forms of his species may be like in color or structure. Furthermore, many of our thrips—especially, it seems, the bark-inhabiting ones, though others are nearly as well gifted—have an almost uncanny facility for getting from place to place, even negotiating long voyages by ship or wind-aided flight from such distant regions as the Orient, or Africa, or South America,—if, indeed, they have not gone to those areas from ours. Florida has species in common with the regions mentioned, as well as with still other regions just as far away. Our inevitable synonymical burden may in time become great.

Fortunately, however, the type material of the present species constituted a single colony. There can be no doubt that the several diverse forms described below represent one species, only. The specific name *mutabilis*, meaning changeable, though it would be equally appropriate for any one of a number of allied species, serves nevertheless to draw attention to, and emphasize, some of the points made above.

Hoplothrips (Odontoplothrips) mutabilis, sp. nov.

(Fig. 1-7)

Thoroughly typical of the subgenus and resembling *bruneri* [2]

[1] The cost of the line engraving was borne by Cornell University through its committee on Faculty Research Grants.

[2] *Hoplothrips* (*Odontoplothrips*) *bruneri* (Watson), subgeneric reference new; placed in *Hoplothrips* (from *Plectrothrips*) by Hood, in 1939; 3

in the type of heterogony displayed by the male, but differing most noticeably from all of its close allies by the following characters: (1) in the macropterous female, with the sense-cones on the third and fourth antennal segments long, slender, curved, and surpassing the middle of the following segment (see Fig. 2), and with the pale yellow posterior part of metathorax and the first abdominal segment forming a contrasting light transverse band across the body, readily seen by the naked eye; (2) in the bachypterous female and the male, with the thorax yellow and unshaded, and the second abdominal segment heavily darkened.

FEMALE, FORMA MACROPTERA.—Length about 2.3 mm. (fully distended, 2.9 mm.). *Color* of head, prothorax, mesothorax, and anterior part of metathorax yellowish brown, the posterior part of metathorax and all of first abdominal segment pale yellow, the remainder of abdomen fundamentally yellow but overlain with gray-brown to a variable extent, the whole of segments II-IX sometimes so darkened but usually with their posterior halves or more fading to yellow or nearly so and with a tendency toward lightening at the ends of dark transverse dashes which are often developed just behind the antecostal lines in the median third of segments III-VIII; head darkest in front of ocelli; tube usually yellow across base and in about apical two-fifths, the intervening portion bright brownish orange, the tip lightly shaded with gray; antennae yellow or nearly so in segments I and II and in basal half of III, the remainder of III and all of IV-VIII more or less dark blackish brown, III sometimes yellowish brown throughout, and IV and V often paler apically than at base; legs yellow except for the brown fore and mid coxae, rarely with the mid and hind femora somewhat shaded with brown; fore wings gray-brown, paler in basal half or less, narrowly margined with darker except basally, darkest in anal area, and with a short, median dark streak before middle.

Head (Fig. 1) about 1.3 times as long as width across eyes, broadest across cheeks shortly behind eyes, cheeks rounded to eyes and converging to a point in front of the distinct basal collar, roughened by short transverse striae; base of head finely reticulate, especially at sides; postocular setae brownish yellow, pointed, well separated, about 79 μ long, 179 apart, and 29 from eyes, all other setae minute. Eyes rounded, dorsally about 83 μ long, 57 wide, and 93 apart. Median ocellus about on a line with anterior margin of eyes, flanked by two pairs of setae and a pore. Antennae normal, segment VIII narrowed at base; III and IV (Fig. 2) with the sense-cones long, curved, and slender apically, III with 1 major cone on inner surface margined with darker except basally, darkest in anal area, and with a short, (about 123 μ), semicircularly rounded at tip.

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topotypic paratypes and 145 additional specimens in collection. New synonymy: (1) *H. psidii* Moulton (holotype studied through the kindness of Dr. Edward S. Ross, of the California Academy of Sciences) and (2) *H.* (*Trichothrips*) *wilsoni* Watson (5 topotypic paratypes in collection).

Prothorax (Fig. 1) moderately long, nearly 0.9 the length of head, and less than 1.7 times as broad across coxae as along midline of pronotum; three pairs, only, of large major setae, these pointed, the epimerals about 87 μ, postero-marginals 114, coxals 86, other pronotal setae 13-20 μ; surface with a stria or two near anterior margin and a few at sides and posteriorly, otherwise smooth and shining; median apodeme strong. Pterothorax very lightly sculptured; fore wings with about 8 accessory setae on posterior margin. Legs normal to the subgenus, fore tibiae slightly produced at lower inner surface of apex to form a slight, flattened obtuse spur underlying the base of the tarsus; fore tarsi with a long strong tooth.

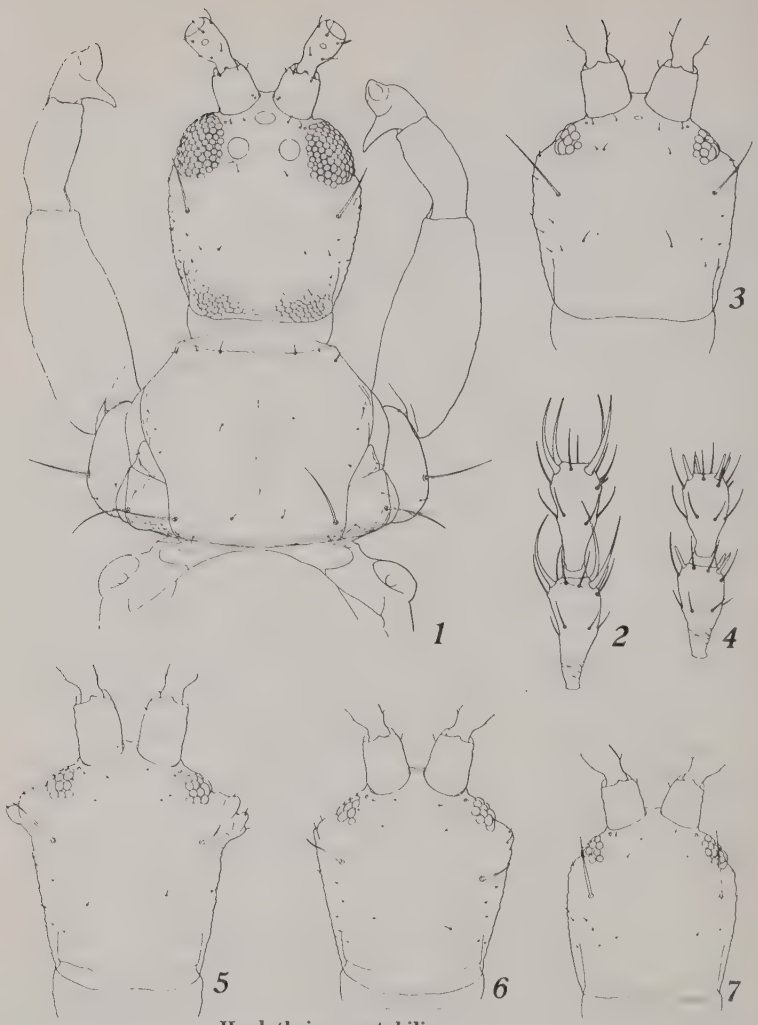
Abdomen normal, its setae long, pointed, and yellow, segment IX with seta I 135 μ, II 142, III 160; one pair of sigmoid wing-retaining setae on III-VII; tube nearly 0.6 the length of head, broadest across basal collar, sides subparallel to basal pores, thence straight and evenly tapering to tip, its sides appreciably thickened, with a few minute setae in apical half or more, surface without sculpture; terminal setae grayish yellow, nearly as long as tube.

MEASUREMENTS of holotype (macropterous ♀): Length about 2.3 mm. (distended, 2.87 mm.). Head, total length 0.291, width across eyes 0.223, greatest width across cheeks 0.238, least width near base 0.172. Prothorax, median length of pronotum 0.259, width across fore coxae 0.428. Mesothorax, width across anterior angles 0.393; fore wings, length 1.09. Metathorax, greatest width posteriorly 0.407. Abdomen, greatest width (at segment IV) 0.462; tube, length 0.168, width across basal collar 0.092, greatest subbasal width 0.087, least apical width 0.043, terminal setae 0.160.

Antennal segments:	I	II	III	IV	V	VI	VII	VIII
Length (μ):	69	73	94	94	76	59	50	50
Width (μ):	51	37	44	44	34	30	25	17

Total length of antenna, 0.565 mm.

FEMALE, FORMA BRACHYPTERA.—Length about 2.3 mm. (distended, 2.9 mm.). *Color* bright yellow, with head often lightly shaded with brown across front and abdomen heavily shaded with gray-brown in basal portions of segments II-VIII, the shading on II darker and more extensive than that on the following segments, occupying about two-thirds of the length and either paler or lacking medially, that on III-VIII consisting of a transverse dash in median third just posterior to the subbasal line and a less clearly defined and paler patch at anterior angles, these latter sometimes nearly connected with the median series of dashes and always less extensive on the more posterior segments; antennae and tube colored as in long-winged form; legs yellow. *Head* (Fig. 3) broadened anteriorly, sculptured as in macropterous form; median ocellus vestigial, others wanting; eyes greatly reduced in size and consisting of few facets; antennae much as in long-winged form, with the same arrangement of sense-cones, but these straight and shorter (Fig. 4). *Prothorax* enlarged, longer than head and only 1.5 times as broad across coxae as along midline of pronotum; fore legs



Hoplothrips mutabilis, sp. nov.

Fig. 1.—♀, macropterous; head and prothorax (setae omitted from all parts excepting head, prothorax, antennae, and fore coxae; paratype, x121.

Fig. 2.—♀, macropterous; segments III and IV of right antenna; paratype, x161.

Fig. 3.—♀, brachypterous; head; paratype, x121.

Fig. 4.—♀, brachypterous; segments III and IV of right antenna; paratype, x161.

Fig. 5.—♂, brachypterous; head of heterogonic maximum individual; paratype, x121.

Fig. 6.—♂, brachypterous; head of medium-sized individual; paratype, x121.

Fig. 7.—♂, brachypterous; head of heterogonic minimum individual; paratype, x121.

longer and stouter (especially the femora), fore tibiae similarly spurred, tarsal tooth longer. *Abdomen* not distinctive.

Measurements of morphotype (brachypterous ♀): Length about 2.3 mm. (distended, 2.89). Head, total length 0.273, width across eyes 0.183, greatest width across cheeks 0.225, least width near base 0.176, width across basal collar 0.181; eyes, dorsal length 0.041; postocular setae, length 0.109, interval 0.169, distance from eyes 0.043; mouth-cone, length beyond posterior dorsal margin of head 0.121. Prothorax, median length of pronotum 0.294, width across coxae 0.444, antero-marginal setae 0.025, antero-angulars 0.025, midlaterals 0.025, epimerals 0.087, postero-marginals 0.093, coxals 0.090. Mesothorax, width across anterior angles 0.375. Metathorax, greatest width posteriorly 0.363. Abdomen, greatest width (at segment IV) 0.437; tube, length 0.160, width across basal collar 0.090, greatest subbasal width 0.085, least apical width 0.042; terminal setae, length 0.153; segment IX, seta I 0.149, II 0.134, III 0.139.

Antennal segments:	I	II	III	IV	V	VI	VII	VIII
Length (μ):	67	70	77	74	62	51	50	50
Width (μ):	53	38	40	38	34	29	26	19

Total length of antenna, 0.501 mm.

MALE (BRACHYPTEROUS): Length 2-2.4 mm. (distended, 2.4-2.9). *Color* as in brachypterous female. *Head* strongly heterogonic, varying extremely in form (Fig. 5-7), large individuals with several large setigerous tubercles on cheeks just behind eyes and with a deep grove on each side just in front of basal collar, small ones without tubercles or groove; sculpture as in female; antennae also variable, large individuals with the segments elongated; sense-cones as in short-winged female. *Prothorax* enlarged and greatly elongated in major forms, sometimes as much as 1.4 times as long as head and only 1.2 times as broad across coxae as along midline of pronotum; fore legs in such forms much elongated, their tibiae with a strong tooth resulting from the prolongation of the *upper* inner surface of apex, their tarsi with the tooth on inner surface very long and stout. *Abdomen* with a narrow and somewhat irregular glandular area on sternum VIII, crossing it at about middle.

Measurements of morphotype (largest ♂): Length about 2.37 mm. (distended, 2.88). Head, total length 0.302, width across eyes 0.185, greatest width across cheeks 0.274, least width near base 0.164, width across basal collar 0.168; eyes, dorsal length 0.040, width 0.031, interval 0.124; postocular setae, length 0.089, interval 0.167, distance from eyes 0.047; mouth-cone, length beyond dorsal margin of head 0.117. Prothorax, median length of pronotum 0.424, width across coxae 0.505, antero-marginal setae 0.013, antero-angulars 0.013, midlaterals 0.015, epimerals 0.093, postero-marginals 0.070, coxals 0.095. Mesothorax, width across anterior angles 0.395. Metathorax, gratest width posteriorly 0.356. Abdomen, greatest width (at segment II) 0.403; tube, length 0.146, width across basal collar 0.084,

greatest subbasal width 0.088, least apical width 0.039; terminal setae 0.146; segment IX, seta I 0.149, II 0.075, III 0.137.

Antennal segments:	I	II	III	IV	V	VI	VII	VIII
Length (μ):	82	73	87	78	70	55	50	51
Width (μ):	51	37	39	37	31	27	24	17

Total length of antenna, 0.546 mm.

Measurements of morphotype (smallest ♂): Length about 1.95 mm. (distended, 2.35). Head, total length 0.228, greatest width across eyes 0.164, greatest width across cheeks 0.192, least width near base 0.154, width across basal collar 0.158; eyes, dorsal length 0.034, width 0.031, interval 0.103; postocular setae, length 0.085, interval 0.145, distance from eyes 0.037; mouth-cone, length beyond posterior dorsal margin of head 0.127. Prothorax, median length of pronotum 0.249, width across coxae 0.382, antero-marginal setae 0.015, antero-angulars 0.015, midlaterals 0.015-0.035, epimerals 0.075, postero-marginals 0.074, coxals 0.090. Mesothorax, width across anterior angles 0.335. Metathorax, greatest width posteriorly 0.322. Abdomen, greatest width (at segment II) 372; tube, length 0.147, width across basal collar 0.080, greatest subbasal width 0.083, least apical width 0.036; terminal setae 0.134; segment IX, seta I 0.130, II 0.074, III 0.143.

Antennal segments:	I	II	III	IV	V	VI	VII	VIII
Length (μ):	60	60	71	62	56	45	44	47
Width (μ):	46	33	36	33	31	26	23	17

Total length of antenna, 0.445 mm.

FLORIDA: Miami, July 23, 1954, J. D. H., 18 macropterous ♀'s, 9 brachypterous ♀'s, and 13 ♂'s (including holotype, allotype, and three morphotypes), from a dead branch on the ground. (Other specimens taken on later days were not included in the type series.)

The Water Beetles of Florida, by Frank N. Young. Gainesville, University of Florida Press, 1954. ix + 238 p., 31 figs. Biological Science Series, Volume V, Number 1. Price $6.00.

Dr. Young's original plan in writing this book was to collect and determine all the species of water beetles known from Florida and to study in detail the various ecological factors influencing their occurrence and distribution. He soon found that the problem of applying names to the various forms was such a difficult and involved task that the greater portion of his time was expended in taxonomic problems. The culmination of this search resulted in the compilation given in this book, including keys to species and ecological notes on each form. The chapter dealing with the ecological distribution of Florida species is particularly illuminating because in this Dr. Young has a clear, yet concise, discussion of the ecological conditions of Florida and those factors which influence the presence or absence of certain beetles in different sections of the state. The results of observations made during the many years spent in roaming over Florida by Dr. Young in his search for water beetles is clearly revealed in his authoritative discussions of the aquatic ecology of the state. The final part of his section on ecological distribution gives his conclusions as to the origin of the Florida water beetles.

The major portion of the book is devoted to an annotated list of 187 species with keys to the subfamilies, genera, and species. Under each species, its taxonomic status and a short diagnosis is given first, followed by distribution, habitat preference, and selected references; taxonomic notes and variations are added where necessary. Pertinent line drawings are included to assist in the use of keys. Ten pages are devoted to references and six to an index to the species.

The University of Florida Press has indeed done the State of Florida a service in publishing this book on water beetles by Dr. Young. Works of this caliber help to enhance the reputations of the institutions at which the studies are done, as well as that of the publishers. The greater part of the investigations reported in this book were carried out while Dr. Young was a student and a staff member at the University of Florida. It is to be hoped that additional works of this sort will be published in the future by the University of Florida Press.

This book, concerned with adult water beetles, will certainly prove to be indispensible to those working in the field of aquatic biology in the southeast, especially in Florida. In spite of its great value, the problems of larval ecology and taxonomy still remain to be investigated. Perhaps in the near future a student of the Coleoptera will undertake such a task. At least we who work in aquatic ecology in Florida can continue to hope so.—L. B.

DRAGONFLIES OF NORTH AMERICA, by James G. Needham and Minter J. Westfall, Jr. xi + 615 pp., col. front., 341 figs. University of California Press, Berkeley, California. 1955. Price $12.50.

At the turn of the century, Dr. James G. Needham, then a young man 32 years of age, announced to those interested in Odonata that he was working on a book of North American dragonflies. It would have been a colossal task if he had attempted publication at that time. As many as 249 (75%) of the 332 species covered by the present volume had been described by 1900. The great amount of revisional work of the current century was still in the future. For example, in the present book there is (pp. 50-51) a list of "Titles Frequently Cited"; of the 22 entries, 15 are for works done in the 20th century, and these do not include such pioneer compendia as R. A. Muttkowski's *Catalogue of the Odonata of North America*, published in 1910 (Bull. 1, Pub. Mus. Milwaukee, Wisconsin).

However, Dr. Needham's usual sound judgment came to his rescue as he realized the great amount of basic and critical work involved and the book was deferred from year to year until 1929 when *A Handbook of the Dragonflies of North America* was published with Hortense B. Heywood as the junior author and with extensive contributions by Elsie Broughton and C. Francis Byers (C. C. Thomas Pub. Co., Springfield, Ill.)

The 1929 handbook was the first comprehensive attempt to bring together available information on the Odonata, both Anisoptera and Zygoptera, known to occur in Canada and the United States. It treated some 360 species and was illustrated with line drawings. Except as a pioneer attempt, the work could hardly be considered an unqualified success. A few months after its publication, Dr. Needham issued an errata sheet running into dozens of items.

Dissatisfied with the 1929 handbook, Dr. Needham, with his usual vigor and courage, began work on a complete and more satisfactory redoing of the project. In 1944 he was joined at Cornell University by Minter J. Westfall, Jr., now associated with this reviewer in the Department of Biology at the University of Florida. They made a fine team. After 10 years of hard work and painstaking attention to minutia, especially on the part of the junior author, the present volume was completed after half

a century of Dr. Needham's original announcement and within a few weeks of his 87th birthday.

This book fulfills admirably the purpose for which it was written: namely, "an authoritative manual, for expert and amateur alike, of the various kinds of Anisoptera found on the North American continent, including the border provinces of Mexico and the Greater Antilles".

To write a book for the layman and the expert is usually not easy to do satisfactorily. If we picture the layman with no more than a very general knowledge of entomology, but with enthusiasm for it, he will find the present book a rather tough proposition. However, by judicious use of keys, pictures, and tables, he will find clearly set out the essential information for the identification of dragonflies and may be stimulated to, in the words of the authors, "enjoy being out of doors with the dragonflies where they haunt natural parks, spring fed brooks, grass-bordered ponds, placid lake shores and winding river banks".

The expert on the other hand, will welcome the bringing together of a large amount of scattered material, the orderly presentation of it, and the very fine illustrations provided. He may be somewhat dissatisfied by the omissions and condensations necessary in any handbook or manual such as the condensed handling of geographic distribution, dates of collection, description of species, and literature references.

The volume is a beautiful example of the printer's art, and is illustrated by one colored plate (frontispiece) and 341 figures mostly half-tones. Practically all of the half-tones are made from photographs supplied by the junior author who spent long hours photographing and very skillfully retouching them. These photographs constitute the greatest original contribution the present book has to offer, and are well worth the increased cost of publication. Dr. Westfall's photographs may be grouped as follows: (1) about 70 from whole specimens illustrating the known genera of nymphs; (2) about 73 illustrating the fore and hind wings of adults for each genus treated; these are large (3″ x 4.5″) and unbelievably clear; (3) some 324 of terminal abdominal appendages (lateral and dorsal views) and/or the 2nd abdominal segment genitalia of more difficult genera such as *Ophiogomphus, Gomphus, Aeschna, Neurocordulia, Somatochlora, Sympetrum;* (4) general, whole or parts of heads, labia, wings, etc.

The book is arranged in two parts. Part One—"Dragonflies in General"—pages 3 to 59, is written in the inimitable style of the senior author and covers the general biology of dragonflies in a broad and delightful manner. This section includes, under separate sub-heads: a description of the dragonfly adult with much attention given to wing venation; the dragonfly nymph; a chapter on "Field Studies" which stresses methods of collecting, mounting, and preservation; and a very useful chapter on "Procedure" giving lists of authors cited, states and provinces included in the manual, titles of important books and monographs frequently cited, and a list of the genera and species treated in the second section of the book.

Part Two—"Systematic Classification"—covers pages 62 to 603 and is the body of the book. It is built on the plan, wherever feasible, of giving a general account of the family and each of its genera with brief diagnostic keys and tables for the species of adults and known nymphs. For each of the 332 species included there is given a concise description of the adult preceded by one or more selected literature references and followed by very condensed statement of geographic distribution by states or provinces, and dates indicating the time of adult activity. With the many excellent photographs already referred to this treatment is quite satisfactory for the stated purposes of the book. Of the vast amount of zoogeographic and ecological information on dragonflies available, very little is included, but one would be asking too much for this also, having been supplied with a generous helping of taxonomy.

In a book as well done as this one is it seems ungracious to mention errors. There are very few of them. The editorial work, most of which fell to Dr. Westfall, has been done with amazing thoroughness. Only a few very minor omissions and transpositions have come to my attention. As examples: *Neurocordulia* (*Platycordulia*) *xanthosoma* has been omitted from the key to adult species of that genus. *Marcromia margarita* has been omitted from the list of unknown nymphs in the key. The labels of figure 187, *Aeschna mutata,* and figure 188, *Aeschna multicolor,* have been transposed. Because of a situation beyond their control the treatment of the genus *Neurocordulia* is not satisfactory. In general the keys are perhaps too brief for accurate use in the more difficult groups, for example: *Tetragoneuria* and *Gomphus.*

The publication of a book such as this manual always represents a mile-stone in the development of any field of scholarly endeavor. A great amount of work on the part of many individuals must come before it, to be followed by an increased awareness of all students of the discipline of deficiencies in their science and a drive toward the completion of work in progress. New students may be attracted to the field with fresh view points and youthful vigor. Equally important, it causes the oldster to contemplate past accomplishments and future directions.

The pattern for the development of our knowledge of North American Odonata culminating in the Needham-Westfall volume was set in substantially its present form through the works of H. A. Hagen and the Baron de Selys-Longchamps a hundred years ago. The late E. B. Williamson and Clarence Kennedy together with Drs. P. P. Calvert, E. M. Walker, and J. G. Needham developed and extended this tradition through the early part of the 20th century. These men directly, and through their students, over the years have extended our knowledge of the North American fauna to a point where new vistas must be opened and investigations along different lines initiated.

With the possible exception of the genus *Gomphus*, the taxonomy of North American Anisoptera is well in hand. Of the species listed in the Handbook, two are based on the nymph only (a somewhat dubious practice), 74% of the immature forms are known (245 out of 332), only a few of the species are in doubt. Routine museum and field work to fill in such blank spaces, extend ranges, and uncover new species is about the extent of the work to be done unless new approaches are made. We must become interested in the whole species instead of a few specimens.

What such new approaches are to be may not be clear or would be made difficult by the very nature of the animals we are dealing with. Controlled studies in ecology, including migration and geographic variation; studies in hybridization; physiological studies are difficult to work out but offer possibilities. Certainly the Odonata offer material and a challenge for biologists interested in other approaches than the taxonomic. One of the many values of Dr. Needham's and Dr. Westfall's book is to emphasize this by bringing the taxonomy to such a high level of attainment.

Having worked with Dr. Needham on the 1929 volume and being associated with Dr. Westfall while the present book was

being completed, I am able to appreciate the genius and drudgery contributed by both in the writing and illustrating of the *Dragonflies of North America.* It is indeed a very satisfactory contribution to our knowledge of one of the smaller but most fascinating groups of insects. Dr. Westfall has promised a companion volume on the Zygoptera or Damselflies of North America for the future, but considering the work involved, it will not be in the near future.

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NOTES

TWO SPECIES OF SAWFLIES PREVIOUSLY UNRECORDED IN FLORIDA

In the past several years, two species of sawflies have been observed in Alachua County, Florida. These species have not been previously reported from the State but it seems likely that they have existed here for many years. Neither species appears to be of economic importance at the present time.

Croesus latitarsus Norton (Hymenoptera-Tenthredinidae): This species has been found in relative abundance on river birch or black birch (*Betula niger* L.) growing on the banks of the Santa Fe River. The insect has the assigned common name of "dusky birch sawfly" and is a defoliator of birch trees in the northeastern United States and Great Lakes region. One generation is the rule in the northern United States with a partial second generation in some seasons. Under Florida conditions there are numerous successive generations beginning when birch foliage becomes available in the springtime.

The larvae are dull green with black spots and glistening black head capsules. Seven pairs of abdominal prolegs are present and a glandular structure is found between the prolegs of each pair. Each larva is approximately one inch long when full grown. Larvae occur in groups, and eight or more may feed on the same leaf at the same time. The posterior end of the abdomen of feeding larvae is curved upward and they have the appearance of so many question marks surrounding a leaf. Prepupae enter the soil where they spin silken cocoons. Adults are black with flattened tibia and tarsi. Confirmation of the identity of the insect was made by Mr. C. F. W. Muesebeck of the U. S. National Museum.

Acantholyda tesselata (Klug) (Hymenoptera-Pamphilidae): This species is associated with loblolly pine (*Pinus taeda* L.) in the Gainesville area. Several of the large black and yellow adults have been collected in recent years. In 1954 a single full-grown larva was found hanging from a silken thread attached to a loblolly pine tree. This larva was pale green with a dorsal and two lateral purplish longitudinal stripes. Prolegs are absent in this species and a pair of terminal abdominal filaments gives the larva the appearance of having a head on both ends. Pamphilid larvae are web-spinners and pine needles are webbed together by the feeding larvae of this genus. The

insect has not been found in abundance and more observations are needed. Newly emerged adults have been dug from the soil during the early spring months which indicates that the winter is passed as prepupae within cocoons in the soil. Since all collections have been during the spring months, there is probably only one generation each year. Identification of the insect was made by Dr. W. W. Middlekauf of the University of California. Previous collection records indicate that the insect is most commonly encountered in the northeastern United States.

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OCCURRENCE OF A SPITTLEBUG IN ANNOYING ABUNDANCE

Observations were made in late 1953 and in 1954 regarding the occurrence of small brown spittlebugs on Fisher Island, Miami Beach, Florida. These insects, identified as *Clastoptera undulata* Uhler (Homoptera, Cercopidae) by Thomas E. Moore, State Natural History Survey, Urbana, Illinois, were found in abundance during December, 1953, and January and May, 1954.

Clastoptera undulata Uhler has been reported previously as occurring in Cuba upon *Casuarina* spp. and various species of Malvaceae. This is its first reported occurrence in the United States and constitutes a verification of the primary host record and the addition of varieties of cultivated *Hibiscus* as secondary hosts.

The nymphs of the species have been observed most frequently in frothy masses of spittle on the Australian pine (*Casuarina equisetifolia* L.) and to a lesser extent on certain varieties of cultivated *Hibiscus*. The adults are active fliers, but when observed resting they were found principally upon the tender twigs of the Australian pine.

Heavy infestations of this insect occurred in December and January; however, by mid-January they had decreased in number until it was difficult to collect even a small series of specimens. Their population increased in April and reached a peak during May. From early June to the present time (September 1954) their numbers have decreased, until the population is as light as that of February and March.

The damage caused by both nymphs and adults feeding on their host plants appears negligible. However, the adults constitute a considerable nuisance by resting or crawling in large numbers on persons who enter the infested area. The adults are often transported in this manner into offices, homes, and automobiles, where their presence is also annoying.

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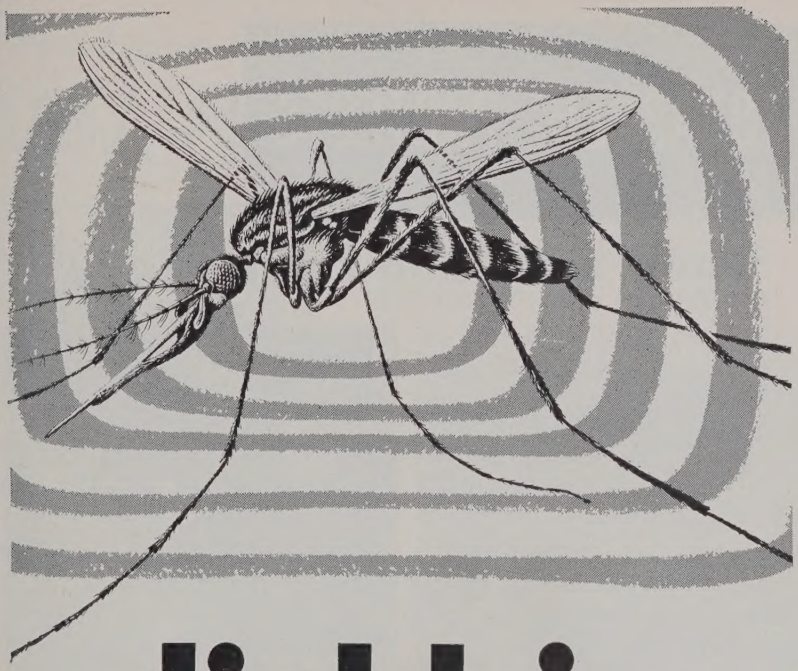

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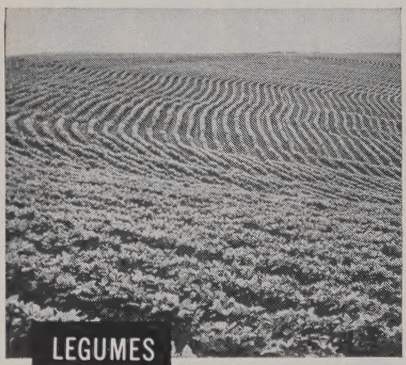

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